

Appl. No. 10/510,417
Amdt. Dated July 16, 2009
Reply to Office Action of March 16, 2009

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Amendments to the Claims:

This listing will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (Currently amended): A piston pump comprising:

a cylindrical cylinder having a cylinder head;

a piston being in a cup shape and having an outer peripheral surface and a cylindrical hollow portion inside, the piston reciprocating inside the cylinder and sliding as the peripheral surface slides directly on an inner wall of the cylinder with predetermined air-tightness;

a suction port through which gas is sucked into a pump chamber defined by the cylinder and the piston; and

an exhaust port through which the gas is discharged from the pump chamber;

wherein the piston pump sucks the gas through the suction port and discharges the gas through the exhaust port as the volume of the pump chamber is changed by reciprocating motion of the piston;

wherein the suction port is arranged at a top of the piston with a suction valve, which opens as the volume of the pump chamber is increased, the piston having a hole at a center thereof in order to fix the suction valve;

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wherein the exhaust port is arranged at a top of the cylinder with an exhaust valve, which opens when the volume of the pump chamber is decreased;

wherein the cylinder is made of a resin and the cylinder head is made of a resin and the cylinder and cylinder head are welded together by ultrasonic welding ~~bonded by welding, and/or adhesion~~ in an air tight manner; and

wherein an inner diameter of the cylinder is adaptedly formed not exceeding 20 mm such that the piston pump can be utilized in a blood pressure measuring device.

Claim 2 (Previously Presented): The piston pump according to claim 1, wherein the suction valve is arranged at a top face of the piston on a side of the pump chamber.

Claim 3 (Previously Presented): The piston pump according to claim 1, wherein the exhaust valve is umbrella-shaped and arranged at a top face of the top of the cylinder outside the pump chamber.

Claim 4 (Previously Presented): The piston pump according to claim 1,
wherein the piston has an opening communicating with the suction port,
wherein the opening is arranged outside the pump chamber so as to allow air sucked through the suction port into the pump chamber to pass and a plenum capable of storing the air to communicate with the opening;

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wherein the plenum is encompassed by an enclosure having at least one plenum suction port; and

wherein the enclosure is in a housing having a base portion fixed to the cylinder such that the base portion holds a motor.

Claim 5 (Currently amended): A piston pump including:

a cylindrical cylinder having a top portion;

a piston being formed in a cup shape with an outer peripheral surface and a cylindrical hollow portion inside, the piston reciprocating inside the cylinder and as the outer peripheral surface slides directly sliding on an inner wall of the cylinder;

a suction port through which gas is sucked into a pump chamber defined by a side of wall of the top portion of the cylinder, a side wall of the cylinder and a top face of the piston; and

an exhaust port through which the gas is discharged from the pump chamber;

a recess portion disposed continuously around an inner wall of the cylindrical hollow portion of the piston in a circumferential direction of the piston;

a coupling ring having a projecting portion that fits on the recess portion such that the coupling ring engages with the piston wherein the cylindrical hollow portion communicates with a center portion of the coupling ring; and

a connecting ring connected to the coupling ring that transmits mechanical force from the connecting ring to the piston;

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wherein the piston pump sucks the gas from the suction port and discharges the gas through the exhaust port as a volume of the pump chamber is changed by reciprocating motion of the piston;

wherein the suction port is arranged at the top portion of the cylinder with a suction valve, which opens when the volume of the pump chamber is increased; and the exhaust port is arranged at the piston with an exhaust valve, which is umbrella-shaped and is arranged outside the pump chamber and opens when the volume of the pump chamber is decreased, the piston having a hole at a center thereof in order to fix the exhaust valve; and

wherein an inner diameter of the cylinder is adaptedly formed not exceeding 20 mm.

Claim 6 (Previously presented): The piston pump according to claim 5, wherein the suction valve is umbrella-shaped and arranged inside the pump chamber.

Claim 7 (Currently amended): The piston pump according to claim 1,
wherein the piston engages with a the coupling ring member in such a manner that the coupling ring member is capable of turning in a circumferential direction thereof, and
wherein the coupling ring member is ~~ring-shaped and~~ connected to a the connecting ring member-driven such that the engaged piston is reciprocated inside the cylinder.

Claim 8 (Currently amended): The piston pump according to claim 7,

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wherein ~~the piston comprises therein a recess portion formed continuously in the circumferential direction of the piston and engaged with the coupling member,~~ the recess portion ~~including~~ includes at least a part of a first predetermined spherical surface;

wherein ~~the coupling member has a projection portion formed continuously in the circumferential direction such that the projection portion corresponds to the recess portion,~~ the projection portion ~~including~~ includes at least a part of a predetermined second spherical surface to engage with the recess portion such that the projection portion is capable of turning in the circumferential direction and in an axial direction; and

wherein the piston reciprocates when the projection portion and the recess portion engage with each other so as to transmit driving force from the connecting ring member to the piston.

Claim 9 (Previously Presented): The piston pump according to claim 1, wherein at least a portion of the piston sliding on the inner wall of the cylinder is ~~composed~~ of a self-lubricating material.

Claim 10 (Previously Presented): The piston pump according to claim 1,
wherein the cylinder comprises a top plenum defined by a top enclosure fixed to the top portion of the cylinder and a motor housing fixed at a position spaced apart by a predetermined distance from the top portion such that the cylinder is connected and fixed to at least a part of the motor housing;

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wherein the motor housing is composed of a base portion fixed to the cylinder such that the base portion holds a motor for driving the piston so as to reciprocate inside the cylinder and a cover portion disposed along the base portion such that the cover portion fastens the motor by sandwiching the motor with the base portion; and

wherein the cover portion and the base portion are engaged with a connecting mechanism capable of engagement and disengagement.

Claim 11 (Previously Presented): The piston pump according to claim 1, wherein the piston pump is connected to a blood pressure monitor.

Claim 12 (Cancelled)

Claim 13 (Currently amended): A method of producing a piston pump including a cylindrical cylinder, a piston reciprocating inside the cylinder; a suction port through which gas is sucked into a pump chamber defined by the cylinder and the piston and an exhaust port through which the gas is discharged from the pump chamber; the method comprising the steps of:

producing a piston pump pre-assembly comprising the cylinder and a cylinder top portion in which the exhaust port is formed, an exhaust valve fitted into a hole in the cylinder top portion so as to cover the exhaust port, and a manifold so that an air chamber is defined wherein the cylinder and the cylinder top are welded by ultrasonic welding and the cylinder top and the

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manifold are welded by ultrasonic welding so as to be air-tight;

conducting a leakage inspection of the air chamber of the piston pump pre-assembly by measuring a change of a pressure applied to the air chamber; and

repairing or discarding the piston pump pre-assembly if it fails to pass the leakage inspection and proceeding with manufacturing the piston pump if the piston pump pre-assembly passes the leakage inspection;

fitting a valve into a hole on the top of the piston so as to cover the suction port thereon wherein the piston is formed in a cup shape with an outer peripheral surface and a cylindrical hollow portion inside which piston reciprocates inside the cylinder as the outer peripheral surface slides directly on an inner wall of the cylinder;

press-fitting a coupling ring into a recess disposed continuously around an inner wall of the cylindrical hollow portion in a circumferential direction of the piston such that a projection portion of the coupling ring fits on the recess portion such that the coupling ring engages with the piston wherein the cylindrical hollow portion communicates with a center portion of the coupling ring wherein a connecting ring is integrally formed with the coupling ring;

press-fitting a crank shaft so a driving shaft of a motor;

inserting the crank shaft into the connecting ring so that a piston-cam-motor sub-assembly is assembled; and

inserting the piston of the piston-cam-motor sub-assembly into the cylinder of the piston pump pre-assembly so as to produce producing a piston pump, by further assembling components

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~~to the piston pump pre-assembly.~~

Claim 14 (Cancelled)

Claims 15-18 (Canceled)